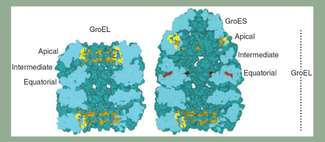
CHAPERONE PROTEINS

/SHap-əŕ-rōn//prō-tēn/ : protein complexes that guide correct protein folding, through a variety of methods

TYPES OF CHAPERONES[1]

CHAPERONINS

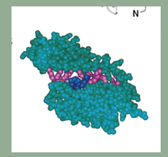
Function by containing proteins in a controlled chamber
Utilizes ATP binding and hydrolysis to drive ordered conformational changes
Can be an Hsp (heat shock protein)



Space filling model of GroEL and GroES, in both open and closed conformations (Chennubhotla, C., & Bahar, I. (2006). Markov propagation of allosteric effects in biomolecular systems: Application to GroEL–GroES. Mol Syst Biol Molecular Systems Biology. doi:10.1038/msb4100075)

HSP70 CHAPERONES

Function by aggregating folding
Substrates undergo repeated cycles of binding and release
All contain highley conserved ATPase



DNAk, a type of HSP70-like chaperone related to DNA replication (Bukau, B., & Horwich, A. (1998). The Hsp70 and Hsp60 Chaperone Machines. Cell, 92, 351-366.)

HSP70

Protein Folding. (2014, February 25). Retrieved November 5, 2015, from http://chemistry.umeche.maine.edu/CHY431/ Folding4a.html

Assist in folding and assembly of new proteins, refolding of misfolded proteins, membrane translocation of secretory proteins, and activity of regulatory proteins.

Associate their substrate binding domain with hydrophobic peptide segments on the protein.

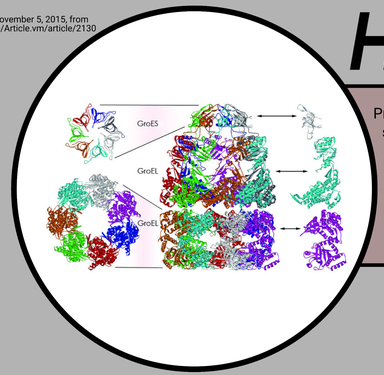
Binding and release is driven by Hsp 70 switching between low-affinity ATP state and high-affinity ADP state.

The ATP cycle is controlled by co-chaperones that also target the chaperones to their targets and determine the lifetime of the complex.

Hsp 70 couples with Hsp90 and Hsp100 to perform more specific tasks.[2]

HSP60/GROEL

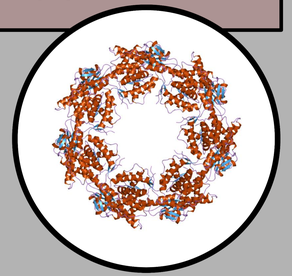
Tom, B. (n.d.). Heat Shock Protein. Retrieved November 5, 2015, from https://www.caymanchem.com/app/ template/Article.vm/article/2130



Prokaryotic GroEL and eukaryotic HSP60 are functionally and structurally nearly identical.

Belong to chaparonin class of proteins.

Function by creating a "climate-controled" cavity inside inner ring where protein folding might occur.[1]



Swaminathan, J. (2009, March 20). GroEL. Retrieved November 5, 2015, from https://commons.wikimedia.org/wiki/File:PDB_1grl_EBI.jpg

HSP90

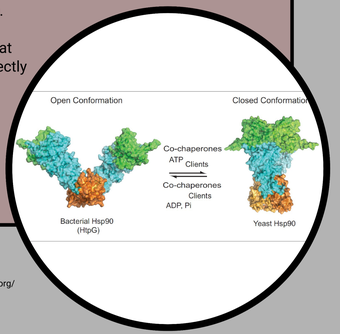
Found in all eukarya and bacteria.

Essential for maintaining the stability of signal proteins, such as steroid hormone receptors and protein kinases.

Mechanisms are largely unknown.

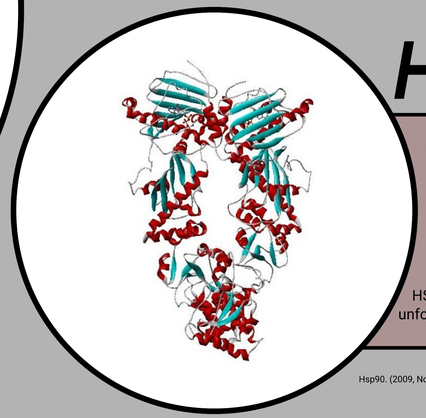
Hsp90 interacts with cofactors that interact with DNA helicases, indirectly affecting gene regulation.

Image shows open and closed conformation of Hsp90, which clamps onto proteins in order to chaperone.[4]



Buchner, J., & Li, J. (2013). Structure, Function and Regulation of the Hsp90 Machinery. Biomed J Biomedical Journal, 36(3), 106-106. Retrieved November 5, 2015, from http://biomedj.org/

HSP FUNCTION



Interact with aggregating non-native proteins and proteins marked for destruction.

HSP70 directs substrates for unfolding, refolding, disaggregation, and degradation.

HSP90 acts with late stages of folding to integrate signalling functions.

HSP60 is part of early folding, and HSP100 is a threading machine for unfolding.[3]

Hsp90. (2009, November 10). Retrieved November 5, 2015, from https://upload.wikimedia.org/wikipedia/commons/d/d8/Hsp90.jpg

WORKS CITED

1. Bakau, B., & Horwich, A. L. (1998). The Hsp60 and Hsp70 chaperone machines. Cell. 92(30), 351-366.

2. Mayer, M. P., & Bukau, B. (2005). Hsp 70 chaperones: Cellular functions and molecular mechanism. Cell Mol Life Sci, 62(6), 670-684.

3. Saibil, H. (2013). Chaperone machines for protein folding, unfolding, and disaggregation. Nature Reviews Molecular Cell Biology, 14(10), 630-642.

4. Zhao, R., & Houry, W. A. (2005). Hsp90: a chaperone for protein folding and gene regulation. Biochem Cell Biol, 83(6), 703-10.

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